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Transitions in dynamics of acoustic emission at stick-slip movement of rock samples at different stiffness of spring-block system

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In experimental geophysics stick-slip movement of rock samples often is considered as a proxy of the earthquake occurrence along a preexisting crustal fault. Therefore, exhaustive investigation of frictional motion between rock samples, especially, transitions from stable to stick-slip motion is very important from both fundamental scientific and practical points of view. One of the accepted approaches to investigating of stick-slip process is the analysis of accompanied acoustic emission (AE). In the present work, AE of the stick-slip movement of basalt samples has been investigated in laboratory slider-spring device. Exactly our laboratory set up consists of supporting (fixed) and sliding plates of roughly finished basalt samples. The load point or "free end" of the spring, attached by other end to sliding block, was driven with a constant velocity Vd = 2,9 mm/sec. It should be mentioned that influence of different internal and external factors affecting stick-slip motion (e.g. sliding rate, cumulative slip, roughness and other features of contact area, contact time, normal stress, spring stiffness, presence of gouge, fluids, environmental conditions, etc.) is poorly investigated. Therefore, we aimed solely at investigation of the influence of spring stiffness on the statistical and dynamical characteristics of stick-slip generated AE, keeping constant other factors mentioned above. Numerous experiments have been carried out for different values of stiffness of pulling spring Ks, exactly, eight different regimes of stick-slip movement have been investigated. From recorded AE wave trains corresponding time series have been compiled and analyzed by modern data analysis methods. The obtained results show that dynamics of stick-slip process undergoes both qualitative and quantitative changes at transition from stick-slip to stable sliding friction caused by increased stiffness of frictional system. Extent of regularity in stick-slip process, assessed by analysis of AE temporal distribution characteristics, increased for stiffer springs. It follows from our analysis that changing the stiffness in frictional system (rock samples) invokes qualitative as well as quantitative differences both in AE wave forms and in statistics and dynamics of AE bursts distributions. These results and similar analysis will help in better understanding the physics of fault stick-slip motion and mechanisms of earthquake preparation.